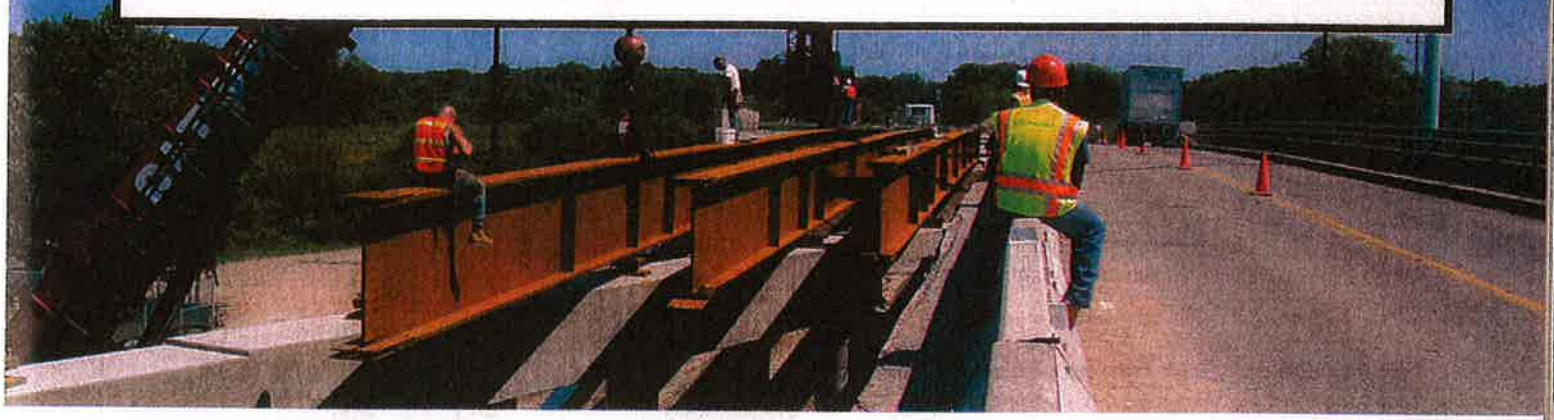
Innovative Material

Bridge's Arms of Steel Contain Copper, Nickel

by Karen Schwartz



The groundbreaking, high-performance steel used on the North Milwaukee Avenue Bridge in Lake Villa, Ill., contains a percentage of copper and nickel and is reportedly no more expensive to produce than conventional steel. The contractor says there were no special needs or problems in erecting the steel.

Located on Illinois Route 83 above the Canadian National Railroad tracks, the North Milwaukee Avenue Bridge in Lake Villa, Ill., is only the second bridge in the world to use a groundbreaking, high-performance ASTM A710 Grade B steel and the first bridge to use this particular steel for main load-carrying members.

Completed in October, the bridge has a span of approximately 430 ft and replaces the original bridge, which was erected in 1930 and widened in 1964 and again in 1971 to accommodate more traffic. The new bridge was constructed by Glendale Heights, Ill.-based Dunnet Bay Construction Co. and designed by the Chicago office of Milwaukee-based Graef, Anhalt, Schloemer and Associates.

Mittal Steel USA of Coatesville, Pa., produced the steel, and it was fabricated at Gary, Ind.-based Industrial Steel Construction.

Christopher Hahin of the Illinois Department of Transportation was instrumental in the preliminary testing of the steel by outside laboratories and included the steel in the American Society for Testing and Materials' A710 Standard for steel.

Christian Crosby, director of quality and engineering at Industrial Steel Construction, supervised the girder fabrication, and IDOT project engineer Nunzio Biondolillo supervised the bridge assembly at the site.

High-PSI Steel The steel, which has a strength of 70,000 psi (compared with 50,000 psi in commonly used structural steel), was developed by Morris Fine, professor emeritus of materials science and engineering at Northwestern University in Evanston, and his colleague, research professor Semyon Vaynman, with support from Northwestern's >>

ABOVE: The North Milwaukee Avenue Bridge in Lake Villa, Ill., is the second bridge in the world to use a groundbreaking, high-performance steel and the first to use the steel for main load-carrying members. (Photo courtesy of Dunnet Bay Construction Co.)

Infrastructure Technology Institute.

The development of the steel began in the early 1990s with a small grant from the Federal Highway Administration. The steel was first used in 2000 to seismically retrofit the approaches of the Poplar Street Bridge over the Mississippi River near St. Louis.

Vaynman says the steel contains approximately 1.5% copper and up to 1% nickel, is no more expensive to produce than other construction steels, takes no longer to produce than other alloys and is less difficult than other alloys to fabricate. He says it's easy to weld and no preheat is required.

Vaynman adds that the small amount of copper in the steel makes it strong and tough at lower temperatures and also ensures that it will better withstand weathering and corrosion than other types of steel.

"The ASTM 710 Grade B steel, or NU-Cu (Northwestern University Copper) as we called it, can be easily produced by any small or big steel company because unlike some competing steels, our steel does not require any special treatments such as thermomechanically controlled processing during rolling or quenching and tempering after hot rolling," Vaynman says. "Our steel is just hot-rolled to a specified thickness and then air-cooled.

"Since no special processing is required, the steel can be produced in any length, thus less welding was required during the fabrication of the bridge. Because the steel is strong, withstands low temperatures, is easily weldable, corrosion resistant and economical to produce, this steel can be used in commercial construction and to build ships and erect platforms for oil exploration."

'Working with the new steel didn't require the purchase of any new equipment, and no changes to our normal procedures were necessary in order to erect the bridge.'

The steel was developed by (from left) professors Morris Fine and Semyon Vaynman, both of Northwestern University. (Photo by Sam Levitan)

Because the steel is weather resistant, the bridge in Lake Villa was left unpainted, Vaynman says. This resulted in about a $300,000 savings in the initial cost and will lead to more savings in the future because the bridge will not need the maintenance that is typically required for painted steel bridges.

The steel forms oxide during aging and "changes during aging from reddish-brown to brown and then to a very dark brown," Vaynman says.

Since the high-performance steel contains copper, the oxide that is formed on the surface protects the steel from further oxidation better than oxide formed on other weathering steels, he adds.

Problem-Free Project Project manager Michael Paine of Dunnet Bay Construction Co. says he is pleased with the outcome of the project.

"I would say that it was a successful project, and in the end, it is a nice long bridge of structural steel," Paine adds. "There have been no known problems with the bridge, and I don't expect any problems. Working with the new steel didn't require the purchase of any new equipment, and no changes to our normal procedures were necessary in order to erect the bridge."

He says the only challenge was working around the railroad and power lines. There was a lake on the west side of the bridge, power lines over the bridge on the south side and two active railroad tracks below the center span of the bridge.

"It was difficult to get cranes and other equipment onsite to erect the steel into place," Paine says. "But we worked closely with the railroad and utility companies to shut down the power lines and portions of the track in order to safely erect the bridge."

Vaynman says the bridge stands as a testimony to all the hard work he and others put in on the development of the steel and the construction of the bridge.

"Northwestern University did not get a patent for the steel; therefore, we do not get a monetary award," he says.

Northwestern's patent office decided not to seek a patent because the steel was not likely to be profitable, Fine says.

"Still, it is great to see the steel we worked on for many years to be used in a bridge," Vaynman adds. "It is like seeing your baby grow." <<

Useful Sources

Find out more about innovative steel by contacting the organizations mentioned in this report:

- American Institute of Steel Construction Inc., 312-670-2400, www.aisc.org.
- Northwestern University Infrastructure Technology Institute, 847-491-8165, www.iti.northwestern.edu.